Mechanical Behavior of Metal Thin Films and Shape Memory Alloy Coatings

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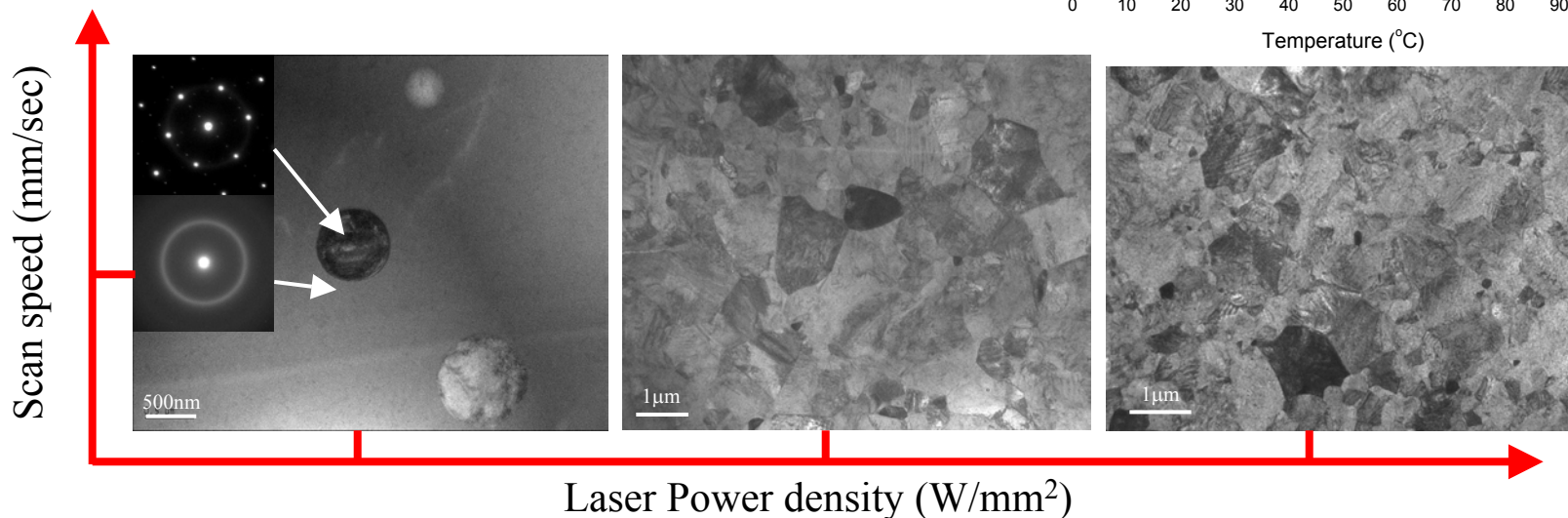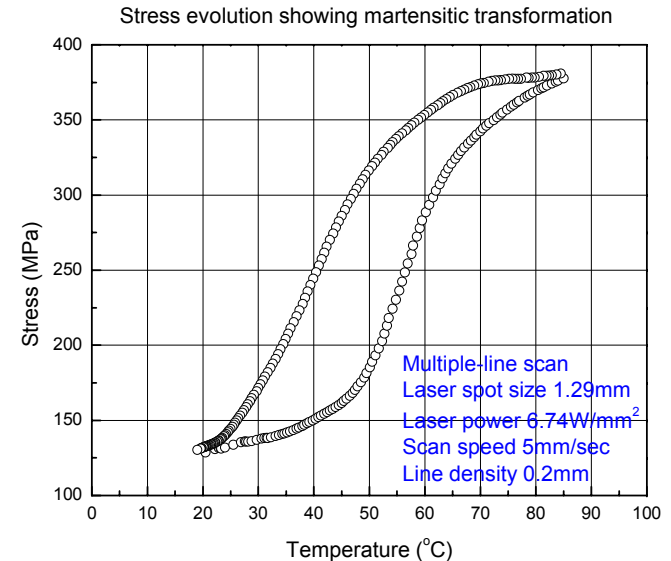
Scanning Laser Annealing of Amorphous NiTi Thin Films

Motivation

-Selectively impart shape memory properties

-Evaluate effect of microstructure on SM properties.

Results

A laser beam is scanned across an amorphous NiTi film. The resulting microstructure depends on laser power density as illustrated in the TEM micrographs below. Annealed films show a distinct shape memory behavior as demonstrated in the stress-temperature curve on the right.

Stress evolution showing martensitic transformation

Multiple-line scan
Laser spot size 1.29mm
Laser power 6.74W/mm^2
Scan speed 5mm/sec
Line density 0.2mm

Scan speed (mm/sec)

500nm

1μm

1μm

Laser Power density (W/mm^2)

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Education

Three graduate and two undergraduate students contribute to this project:

Graduate students:

■ Yong Xiang is working on the mechanical behavior of elemental metal films, Xi Wang is investigating NiTi shape memory coatings and is responsible for most of the laser annealing work, Patrick McCluskey is investigating ferro-magnetic shape memory alloy coatings.

Undergraduate students:

■Ann Lai, a junior undergraduate student at Harvard University, optimized deposition conditions for the amorphous NiTi coatings and investigated the interaction of NiTi with the underlying substrate under various annealing conditions. Iping Lam is currently a junior at Lehigh University. He worked on the crystallization heat treatments of NiTi.

■Work was done in collaboration with the Research Experience for Undergraduates Program at Harvard University (summers 2003-2004), the Harvard MRSEC, and Dr. Bellouard at RPI.

Broader Impact

Publications:

■This work has resulted in seven publications in various journals and conference proceedings.

■Graduate students Yong Xiang and Xi Wang have presented their work at several conferences.

Awards

■Yong Xiang received the best poster award at the Gordon Research Conference on thin film mechanical behavior for his work on thin Cu films.